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ABSTRACT

Part of the Understanding Our Environment project that is designed to engage students in investigating specific environmental problems through concrete activities and direct experience, students work individually and in groups to plan a future community in order to gain an understanding of how greatly increased human populations impact resources, energy, food, water, air, and the living environment. The objectives include: discovering the reproductive potentials of living organisms and considering the relationship between population growth and limiting factors in environments; determining how human population growth affects resources; understanding the extent to which people can live in harmony with their environment and the way people modify the environment to fit their needs; understanding the components of a sustainable society and the role technology plays in maintaining the balance; understanding the characteristics of societies and the effects of change on cultures and lifestyles; investigating the use of resources and the impact on the environment of human populations in different countries and regions; describing the dynamics of human population growth by comparing demographic measurements of human populations in different places and times; and investigating what is being done throughout the world to solve problems caused by increased population. (JRH)

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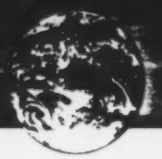
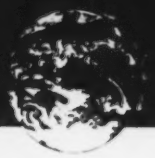


PEOPLE

Ann Tweed

This publication is dedicated to Dr. Alan L. McClelland for his many years of devoted work at DuPont, in the government, and in the community to develop and educate people of all ages in mathematics, engineering, and chemistry. His commitment to advancing the understanding of the sciences has influenced thousands of lives and careers around the world.



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Ann Tweed is an environmental science teacher and coordinator for science at Eagle Crest High School, in the Cherry Creek School District, Aurora, Colorado.

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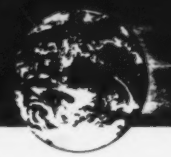

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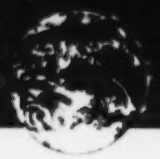


How Many People Would Be Too Many?

Human populations will continue to increase worldwide. What will human communities look like in the future? With ever increasing population, it will be a challenge for human populations to maintain a sustainable environment. Traditionally, people have lived in harmony with their environment in some ways and in other ways human populations have modified their environment to fit their needs. Working individually and in groups, students will plan a future community. In the process, they will gain an understanding of how greatly increased human populations impact resources, energy, food, water, air and the living environment.

Objectives

- Discover the reproductive potentials of living organisms and consider the relationship between population growth and limiting factors in their environments.
- Determine how human population growth affects resources like food, land, air, water, and energy.
- Understand the extent to which people can live in harmony with their environment and the ways people modify the environment to fit their needs.
- Understand the components of a sustainable society and the role technology can play in maintaining the necessary balances.
- Understand the characteristics of societies and the effects of change on cultures and lifestyles.
- Investigate the use of resources and the impact on the environment of human populations in different countries and regions.
- Describe the dynamics of human population growth by comparing demographic measurements of human populations in different places and times.
- Investigate what is being done throughout the world to solve problems caused by increased population.

Project: Design a Future Community

In this introduction to the project, students learn of their assignment to design a future community and begin to think about what is involved. They conduct a brief investigation of the local community as a preliminary exercise.

The project will be completed at the end of the unit as a group effort. To prepare students for making realistic decisions about their future community designs, do as many of the unit's activities as possible. Some activities include development of plans that can be used in the project. Have students save all their work, so they can refer to it when the design process begins.

The main objectives of this project are (1) to learn about the effects of population growth, (2) to understand the components of a sustainable society and the role technology can play in maintaining the balance, and (3) to understand how people fit into their environment and how they modify it to suit their needs.

Teaching Notes

Materials: Provide city or community maps for the students to use in the study of their community. (You may wish to use the maps students worked with in the Land unit.) Have students find out how they can contact the city or county planning commission.

Grouping: Work on the final design of future communities will be done both individually and in cooperative groups of three or four, which will divide up the responsibilities for parts of the project.

Restrictions: You may wish to limit students' final choices of locations for their communities to achieve a balance of countries around the world. Final choices will be made later, at the end of the unit.

Concepts: You may wish to clarify the meaning of certain concepts as necessary throughout this unit, such as the difference between a community as a biological unit and a sociological one. It is also helpful to explain the difference between a problem and an issue. There are many sensitive issues associated with population growth. The question of whether population growth is a problem is itself an issue.

Planning Note: Plan ahead for the activity "Looking at *Lemna*" by setting up the aquarium and starting the plants now or before you begin this unit. The growth of *Lemna*, an aquatic plant, must be observed over at least two weeks.

Plan and Preparation

Choose which activities in this unit you will have the class pursue, and plan ahead for them.

Ask students to start a notebook to use throughout this unit. The quality of this student project depends on the students' keeping a complete record of all activities. Introduce the project idea and direct the students in brainstorming their list of topics to study so the class's list will be consistent with your plans for activities.

When students study their community, you may ask a member of the planning commission to discuss basic laws relating to zoning and land use.

Extensions

1. Have elementary students make a collage of pictures that tells the story of their community through illustrations. They can use clippings, photographs, student artwork, and any three-dimensional materials.

2. High school students can create a grid map of their community placing the various components of the community in the correct locations. (The technique of mapping on a grid is discussed in the Water unit.) You may also want students to work with SIM City, a computer simulation by Maxis (or its sequel, SIM City 2000), which allows them to create and design a city. (For more information on SIM City, call Maxis at 1-800-996-2944.)

Project: Design a Future Community

The world's population in 1995 is more than 5.7 billion. Every day, about 386,000 more people must share Earth and its limited resources. Although birth rates are declining in some parts of the world, between now and 2025, the world's population will increase by about 2.8 billion.

With so many more people, how will we feed everyone? Where will we put our wastes? How will we provide fresh water? Traditional methods of meeting needs in densely populated "less developed" countries and the rate of use of natural resources and generation of wastes in "more developed" countries are both unsustainable. For the world to continue to meet the needs of its inhabitants at present levels, development must be carefully planned and strategies must be modified.

An urban community

A rural community

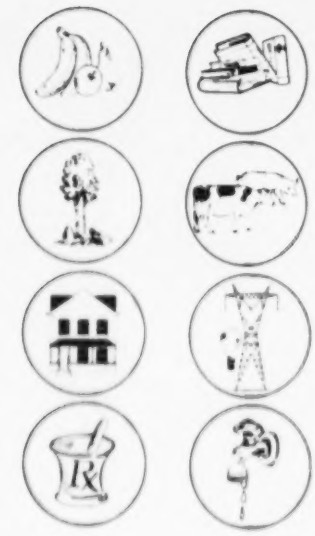
Task

Design a sustainable future community for the year 2030. Decide how your future community will modify the environment and the extent to which it will fit into the environment with the least possible alteration. Plan for meeting all needs of the population without harming the environment and for taking any measures necessary to ensure that the the community continues to thrive. (Your teacher will tell you about restrictions on your choices.) You may work on the plan in groups.

Key Questions

Think about the following questions. They will help you decide how your future community will look. You will prepare to make the decisions for this project as you pursue activities in this unit.

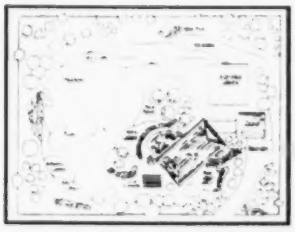
- In what part of the world would you like to live in the future?
- What will you require for survival? What else would you want to have for the quality of life you would like?
- How will you ensure that your community will be sustainable and that the inhabitants' needs will be met?
- How will the population in your future community protect and modify the environment in the place you select?



Sustainable development: practices in agriculture, economic development, health, and education that meet the needs and desires of the current generation without decreasing the ability of future generations to meet their needs.

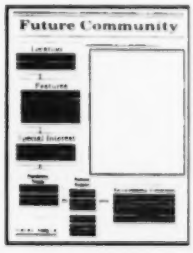
Your final plan should take into account the following factors:

- Continued population growth
- Food supplies
- Freshwater supplies
- Sources of energy
- Supplies of minerals and other resources
- Protection of wildlife
- Prevention of air, water, and land pollution
- Preservation of forests
- Industrial, agricultural, and commercial development
- Housing
- Jobs
- Education
- Health services
- The health and well-being of children
- Political stability
- Quality of life (as you define it)



Presentation

Later, when you have finished planning your future community, you will write a short report and prepare a presentation using overheads, videos, models, posters, blueprints, and any other mediums you choose. Describe where you plan to build your community and the special features that you will include to provide a good quality of life for the people living there. Mention the community's general characteristics and any details of interest. Be ready to explain how your future community will be sustainable and how you will modify and protect the environment.



Getting Started

Before you begin planning, you need to learn more about human populations and current population trends in specific countries and areas of the world. The activities in this unit will help you learn about your local community, countries around the world, and the world as a whole.

Problems of Increased Population

Brainstorming: Why Is Population Increase a Problem?

Part A. In groups of three or four, discuss what you already know about world population. How many people would be too many? Use a large piece of butcher paper and a different colored marker for each member of the group. Going in a circle, record one problem that could result from increased population (such as starvation, air pollution, or increased waste). Continue passing the paper around until your group has run out of ideas. Using your marker, write your name in one corner of the sheet. When all groups have finished, put up your posters around the room.

Part B. Before you begin to plan your future community, make a list of six or seven topics you think you should learn more about to understand the effect of populations on the environment. Examples are rates and effects of population growth, requirements for survival, sources of energy, lifestyles around the world, and ways to limit damage to the environment.

Your class will discuss these suggested topics and decide on a composite list for the class. Be sure to include topics that should be investigated further to provide the information you will need to design your future community.

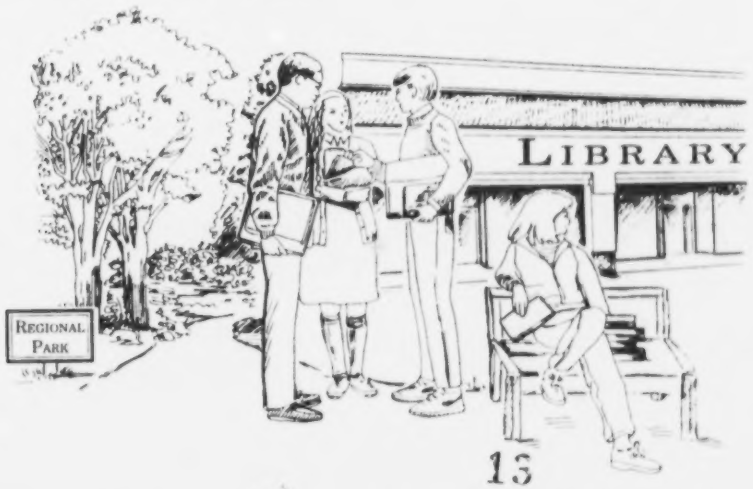
Record the class's list of topics in the box below.

LIST OF TOPICS	
Population growth rate Requirements for survival Sources of energy Sources of food Transportation	

A Look at Your Community

In what kind of community do you live? Use your personal knowledge and any resources you require to provide the following information about your community.

1. Describe the following:
   a. Geographic location
   b. Population size
   c. Community water sources
   d. Energy sources (principal sources and other sources)
2. Describe your community's plan for growth
3. Describe the types of facilities that are available in your community for the following:
   a. Public transportation
   b. Industrial sites
   c. Recreation
   d. Information exchange (libraries, schools, publications, broadcast media)
   e. City or town center (government, business, shopping, and cultural centers)
   f. Entertainment
4. Describe some of the biggest problems facing your community.
5. Describe one issue that is being debated in the community.
6. What two things do you think could be done that would improve your community the most? Explain your answers.
7. Give your personal assessment of your community. Name things that make it a nice place to live and features you would like to see changed.



Food for Thought Activity

How does life in more developed countries compare with that in less developed countries, and how do population growth rates compare? The principal activity in this section is "Food for Thought," reprinted with permission from Zero Population Growth, Inc. This activity demonstrates problems created by uneven distribution of population and resources around the world, as well as problems of overpopulation such as deforestation and overfarming.

Students learn recent world population statistics. They think about related concepts such as growth rate and doubling time and consider some of the determinants of population growth.

Teaching Notes

Grouping: "Food for Thought" was written for 54 students, but the instructions include modifications for groups of 25 to 30.

Materials: Use index cards for citizenship cards. Collect these after each class and use them year after year. You will also need the materials listed in the chart "Region Information" on page 15. Use tape or yarn to divide the classroom into continents, or push laboratory tables together to form proportionally sized areas. Students must occupy their continents. (Any students who are not at a "continent" are "boat people," or refugees, and ambassadors may hear requests for immigration at an appropriate time during the simulation.)

Explanations: The activity uses the United Nations divisions of the world. Note that Europe and Asia do not include the former Soviet Union. Explain "Per Capita GNP" to students, and distinguish it from total GNP. Figures in the activity date from 1992. Mention that there have been some changes since then. World growth rates have begun to slow recently. (See "Looking at Lemna," page 26.) You may also wish to compare birth rates per 1000 people and number of children per woman to clarify the difference.

Substitutions: Use M&Ms instead of Hershey's Chocolate Kisses. Also use toothpicks in clear plastic sandwich bags instead of matchbooks to illustrate energy consumption. (Handing out matches poses a safety hazard.)

Modification: Because the chocolates represent *per capita* GNP, students can judge the relative per-person wealth by comparing the regions' bags of chocolates. If you wish to have ambassadors distribute the candy among the populations, start with enough candy to represent the *total* GNP of the region (the equivalent of one bag per student). Otherwise, the division will exaggerate the differences in wealth among the regions.

Additional Resource: Brouse, Deborah E. (1990, December). Population education. *The Science Teacher, 57* (9), pp. 30-33.

"Food for Thought" and Analysis

Distribute the activity sheets for "Food for Thought" and associated activities. You may wish to have students construct a proportional map of the continents as a prelude, using the Activity Sheet "World Population by Continent."

(There are also posters on population data around the world included in the envelope. Note that population growth has been slowing slightly and estimates of future population reflect these changes.)

Appoint ambassadors or have the citizens of each continent select their ambassador after they move to their assigned continents. You may represent Australia (the only unrepresented inhabited continent). As the ambassadors read their information, the rest of the class should fill out the Activity Sheet "World Population Statistics," then answer the questions on "World Population Statistics Analysis." You may wish to provide clipboards for the students.

Food for Thought**

INTRODUCTION

All societies need and use food and natural resources, but not all societies use them in the same ways. The distribution of food and resources, consumption patterns and the size of a country may differ greatly around the world. This sets the stage for "have" and "have not" societies with the resulting possibilities of social unrest and human discomfort. This simulation helps to demonstrate the unevenness in the distribution of population and resources and the resulting social problems.

After completing this activity, students will be able to state at least two factors that might be used to determine the relative affluence of a country or continent and identify at least two potential impacts of inequitable resource distribution.

ACTIVITY

Materials: Assorted colors of yarn or chalk to make the outlines of six world regions (see "Region Information" chart for size of each region); masking tape (to tape yarn to floor); ambassadors' cards (furnished); six large placards labeled with names of world regions (or small paper signs with pins); long loaf of French or Italian bread and a bread knife *OR* one pound of peanuts in the shell and six paper plates; 28 ounces of Hershey's Chocolate Kisses; 137 matchbooks with matches removed (or 684 used kitchen matches); 12 sandwich-sized plastic bags and 12 twist-ties.

Preparation:

A. Arrange yarn for world regions in rectangles on the floor and tape down. Note that regions in this simulation are those defined by the United Nations; Mexico is included in Latin America rather than North America and the Former U.S.S.R is defined as a region by itself. (The seventh world region, Oceania, is not included in the simulation because its population is so small relative to the others that it cannot be accurately represented.)

B. Slice the loaf of bread, cutting only part-way through the bread, into one piece comprising half the loaf, one piece that is 2/12 of the loaf and four pieces that are 1/12 of the loaf. *OR* write the names of one region on each of the six paper plates and put the number of peanuts required for each region in "the ideal world" on that region's plate (3 peanuts per person; see "Region Information" chart for numbers of people). Put the number of Hershey Kisses* required for each region in a bag and label the bag with the region's name. Do the same for matchbooks or matches.

C. Count the number of participants. The following script is designed to use a total of 54 "citizens" to populate world regions. However, you can adapt the game for 25-30 participants, doubling over the yarn when you lay out region outlines. You can use chairs as "citizens" if you have too few students.

"Extra" people can form a United Nations International Advisory Board. Ask these advisors to closely observe the game and, at the end of it, to recommend at least three policies to help deal with population/food/income inequities among nations. The observers might consider, for example, whether or not these inequities *are* problems and might contemplate such questions as:

(1) Should food aid be given to countries that have not yet effectively dealt with their population problems?

(2) Do donor nations have the right to link food aid to certain policies?

(3) Should rich countries reduce their consumption levels? How could this be encouraged or enforced?

You might write these or similar questions on index cards to give to the advisory board.

Procedure:

Read the following script or use it as a guide to assist students in arranging themselves in world regions.

"I'd like to share with you an activity called 'Food for Thought' that will demonstrate population distribution among world regions as well as urban/rural dwelling patterns, arable (or farmable) land, protein consumption, energy consumption and wealth in the various world regions.

"First, we need six volunteers to be ambassadors from these world regions." (If no one volunteers, quickly appoint them. Give all ambassadors their ambassador's information cards and ask them to stand inside their regions' outlines.)

Population distribution: "Would the ambassadors please choose some citizens to help populate their regions. The ambassador from North America will need to pick two citizens, the ambassador from Latin America, three citizens; from the Former U.S.S.R, two citizens; from Africa, six citizens; from Europe, four citizens; and from Asia, 31 citizens.

*Editor's Note: To calculate the correct number of M&Ms or Hershey's Chocolate Kisses, you must first multiply the number in the Region Information table by the number of students representing the region's population, so the number of candies will accurately reflect the relative GNP of the regions.

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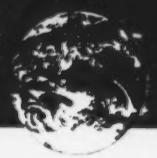
TEACHER'S NOTES : PEOPLE FOOD FOR THOUGHT



Give the sign (pin it on) or placard labeled with the name of the world region to each ambassador.

"Ambassadors, would you please tell us something about your regions by reading the cards you have. First, let's hear about the birth rates in all the regions." (Make sure students understand the definition of birth rate—the annual number of births per 1000 population—and then have each ambassador in turn read his or her region's birth rate. If possible, have someone write the numbers as they are read on a chart on the blackboard or on an overhead transparency. Repeat this procedure for other variables listed on the ambassadors' cards, e.g., death rate, infant mortality rate, doubling time, etc. When finished, collect the ambassadors' cards.)

Land use: "Next, let's look at land areas and how they're used. How many people are there compared to the amount of land in each region? How many people live in cities? How much arable land is there per person?"

"North America has 16 percent of the world's land area but has five percent of the world's population. In North America, 3/4 of the population live in urban areas. So, North American ambassador, would you please have 3/4 of your people stand on the border of the region (which represents urban areas), away from the countryside. The remaining 1/4 can move into the middle (countryside) and be farmers. Unfortunately, though, not all of the land in the countryside is arable (capable of being farmed); the farmers will have to confine themselves to only a portion of the region. In North America, only 1/8 of the land is arable, so farmers, would you move into 1/8 of the total space." (For other regions, turn to the chart at the end of this script and continue as above.)

"This demonstration provides an answer to people who say, 'With all that land to farm, how can there be food scarcity?' We see that there is much less arable land per region than most people think. How might population growth contribute to a reduced amount of arable land?" (Deforestation, as more and more people gather wood for fuel and housing or clear land for grazing, reduces the root systems that keep soil from being eroded by rain and wind. Removal of vegetation also keeps the soil from being replenished by leaves and other plant matter and the waste of animals whose habitat has been eliminated. Some land might also be overfarmed or overgrazed, making it ultimately infertile.)

Energy consumption: "Now let's look at energy use in the various regions. I will give each ambassador a bag of matchbooks (or matches) that stand for that region's per capita consumption of commercial energy in a recent year. Ambassadors, don't open the bags; just hold them." (Hand out bags one at a time. Then have all ambassadors hold them high so that everyone can see them.) "Per capita energy consumption is one measure of how much each person in a given region uses natural resources. As you can see, the average person in North America uses much more energy than the average person in many other world regions. That is why, even though North America's population is growing slowly, the region is an important contributor to a growing imbalance of population and resources worldwide." (Collect the bags.)

"Next, let's look at protein consumption in the regions." (Do one or the other of the following two versions.)

Protein consumption—version one, by region: "This loaf of bread represents protein consumption per day in the world. North America gets 1/12 of this loaf. Would the North American ambassador please come get North America's share of the world's protein and distribute it among the population as you see fit, given the political realities of the region. Latin America also gets 1/12 of this loaf. Would the Latin American ambassador..." Proceed as above for the USSR (1/12), Africa (1/12), Europe (2/12) and Asia (6/12).

Protein consumption—version two, per capita: Version two (with peanuts)—per capita protein consumption: "In the ideal world, every person would consume an optimum protein standard of 100 grams per day. Each peanut represents 33-1/3 grams, so a well-fed person would receive three peanuts." Hold up the first region's plate with the "ideal quantity" to show citizens of the region how much they "should" be getting. Then remove a portion of the peanuts (if appropriate) to portray the quantity they would get in the "real" world. For example, if Asia were a well-fed region, all 32 citizens would get three peanuts each, for a total of 96 peanuts. Unfortunately, they get only 64 peanuts (sweep off 32 peanuts, perhaps pre-divided on the plate using a cardboard strip or plastic bag). Now ask the ambassador to distribute these peanuts as he or she sees fit and the citizens to respond as they see fit, bearing in mind the political and geographic realities of the region. Tell the Asian citizens that if their ambassador distributes the protein equitably, each citizen would get only two peanuts. (Repeat for other world regions.)

At this stage of the activity, interesting things might happen. Sometimes ambassadors keep too much food for themselves or don't distribute it fairly among the citizens. Sometimes revolution is threatened, or citizens steal food from each other. Sometimes there is legal or illegal immigration to a region that has more food; the new immigrants may or may not be offered a share of the wealth. There may also be demands for foreign aid. When any of these things happens, ask, "Does anything like this happen in the real world?" and discuss the examples students offer.

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Distribution of wealth: "Finally, let's look at the distribution of wealth in these six regions. We will use Hershey's Chocolate Kisses to represent the per capita gross national product (GNP) of each world region. Let each candy represent $300 per capita GNP; e.g., North America has a per capita GNP of $21,580 according to 1990 statistics, and it would get 72 candies." Distribute the appropriate number of candies, in plastic bags, to ambassadors, asking them not to open bags yet. Then ask ambassadors to hold up their bags so everyone can see the relative per-person wealth in the different world regions.

Say, "Remember this is one person's share of the wealth in each region. But just to further illustrate a point about what happens when there are not enough resources to supply everyone who wants them, I'd like the ambassadors now to distribute the Kisses as they see fit and the citizens to respond as they see fit." Again, at this point in the activity, any number of interesting things might happen; as events occur, ask, "Does anything like this happen in the real world?" If too much happens at once, talk about what happened later, after students have taken their seats, discussing one region at a time.

At the conclusion of this activity, ask students to recall how many years it would take Asia's population to double at current growth rates. Ask, "If we tried to do this activity again that many years from now, with this same yarn border, would we be able to? What difference would it make to North America if Asia's population were to double in that time period?" (There might be increased immigration pressures, disruption of import and export markets, increased demand for foreign aid, international conflicts, even climate change triggered by the larger population's increased consumption of fossil fuels.)

Adapted from *Food for Thought Kit*, Population Research Bureau, Inc., 1875 Connecticut Avenue NW, Suite 520, Washington, DC 20009.

REGION INFORMATION
(based on 54 participants)

	North America	Latin America	Europe	[Former] U.S.S.R.	Asia	Africa
Yarn*	11 m	10.7 m	5.5 m	11.2 m	12.2 m	12.8 m
1992 Population (1 = 100 million)	3	4	5	3	32	7
Percent of World's Land Area	16%	15%	4%	17%	20%	22%
Urban Population	3/4	7/10	3/4	2/3	1/3	1/3
Arable Land (1989)	1/8	1/10	1/3	1/10	1/6	1/16
Peanuts (Real World Share)	3/person	2/person	3/person	3/person	2/person	2/person
Bread	1/12 loaf	1/12 loaf	2/12 loaf	1/12 loaf	6/12 loaf	1/12 loaf
Per Capita GNP (1990)	$21,580	$2,170	$12,990	$9,210	$1,680	$630
Number of Kisses	72	7	43	31	6	3
1998 Per Capita Energy Consumption						
Gigajoules/Kitchen Matches	297	33	129	190	23	12
Matchbooks (1 = 5 Gigajoules)	59	7	26	38	5	2

*Editor's note: English measure has been changed to metric measure.

NOTE: To conduct this simulation with 26 participants, double over the yarn (or use half as much) and distribute the population as follows: 1 in North America, 2 in Latin America, 3 in Europe, 1 in the U.S.S.R., 16 in Asia and 3 in Africa.

The Baltic countries of Estonia, Latvia and Lithuania are included in Europe.

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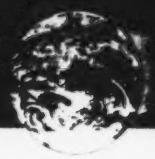

"FOOD FOR THOUGHT" AMBASSADORS' CARDS (1992)

The African Ambassador
I am the African Ambassador. Here are some of the statistics that shape my region of the world:
A. Our population is estimated at 654 million.
B. Our birth rate is 43 per 1000.
C. Our death rate is 14 per 1000.
D. Our population's annual growth rate due to natural increase is 3.0%.
E. At this rate, we will double our population in 23 years.
F. By the year 2025, we are projected to have 1 billion, 540 million people.
G. Our infant mortality rate is 99 per 1000.
H. Our life expectancy at birth is 54 years.
I. We have .29 hectares of arable land per person.
J. African women bear an average of 6.1 children.

The Russian Ambassador
(Former Soviet Union)
I am the Russian Ambassador. Here are some of the statistics that shape my region of the world:
A. Our population is estimated at 284 million.
B. Our birth rate is 17 per 1000.
C. Our death rate is 10 per 1000.
D. Our population's annual growth rate due to natural increase in 0.7%.
E. At this rate, we will double our population in 104 years.
F. By the year 2025, we are projected to have 362 million people.
G. Our infant mortality rate is 39 per 1000.
H. Our life expectancy at birth is 70 years.
I. We have .81 hectares of arable land per person.
J. Russian women bear an average of 2.2 children.

The North American Ambassador
I am the North American Ambassador. Here are some of the statistics that shape my region of the world:
A. Our population is estimated at 283 million.
B. Our birth rate is 16 per 1000.
C. Our death rate is 8 per 1000.
D. Our population's annual growth rate due to natural increase is 0.8%.
E. At this rate, we will double our population in 89 years.
F. By the year 2025, we are projected to have 363 million people.
G .Our infant mortality rate is 9 per 1000.
H. Our life expectancy at birth is 75 years.
I. We have .85 hectares of arable land per person.
J. North American women bear an average of 2.0 children.

The European Ambassador
I am the European Ambassador. Here are some of the statistics that shape my region of the world:
A. Our population is estimated at 511 million.
B. Our birth rate is 12 per 1000.
C. Our death rate is 10 per 1000.
D. Our population's annual growth rate due to natural increase in 0.2%.
E. At this rate, we will double our population in 339 years.
F. By the year 2025, we are projected to have 516 million people.
G. Our infant mortality rate is 11 per 1000.
H. Our life expectancy at birth is 75 years.
I. We have .30 hectares of arable land per person.
J. European women bear an average of 1.6 children.

The Asian Ambassador
I am the Asian Ambassador. Here are some of the statistics that shape my region of the world:
A. Our population is estimated at 3 billion, 207 million.
B. Our birth rate is 26 per 1000.
C. Our death rate is 9 per 1000.
D. Our population's annual growth rate due to natural increase is 1.8%.
E. At this rate, we will double our population in 39 years.
F. By the year 2025, we are projected to have 4 billion, 998 million people.
G. Our infant mortality rate is 68 per 1000.
H. Our life expectancy at birth is 64 years.
I. We have .15 hectares of arable land per person.
J. Asian women bear an average of 3.2 children.

The Latin American Ambassador
I am the Latin American Ambassador. Here are some of the statistics that shape my region of the world:
A. Our population is estimated at 453 million.
B. Our birth rate is 28 per 1000.
C. Our death rate is 7 1000.
D. Our population's annual growth rate due to natural increase is 2.1%.
E. At this rate, we will double our population in 34 years.
F. By the year 2025, we are projected to have 729 million people.
G. Our infant mortality rate is 52 per 1000.
H. Our life expectancy at birth is 67 years.
I. We have .45 hectares of arable land per person.
J. Latin American women bear an average of 3.4 children.

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World Population Statistics (1992 Figures)

	North America	Former Soviet Union	Europe*	Latin America	Africa	Asia*
Population (millions) in 1992						
Birth Rate/Death Rate (per 1,000)						
Annual Growth Rate (%)/Doubling Time						
Est. Pop. in 2025 (millions)						
Infant Mortality Rate (per 1,000)						
Life Expectancy (years)						
Arable Land (hectares per person)						
Average Number of Children (per woman)						

*Excluding the former Soviet Union.

World Population Statistics Analysis (1992 Figures)

	Continent with Highest	Continent with Lowest
Population		
Birth Rate		
Death Rate		
Annual Population Growth Rate		
Infant Mortality		
Number of Children per Woman		
Life Expectancy		

Questions

1. How might birth rates and population growth rates be reduced in countries where they are high?
2. Why are infant mortality rates and death rates high and life expectancies low in less developed countries compared to those of more developed countries?
3. What are some cultural and medical reasons for women in some countries to have many children?
4. What are some cultural factors that might lead to lower birth rates?
6. What are some medical and other reasons for high population growth rates?
7. Should less developed countries be encouraged to control their population growth rates? If so, how? If not, why not?
8. Should more developed countries be required to reduce their consumption levels of energy, food, and other natural resources? Should they voluntarily do so? Explain your answers.

World Population by Continent

In this activity, your class will make maps of continents or regions, then put those maps together to form a world map. Instead of the usual geographic map, you will make a map that has an area proportional to the size of each continent's or region's population.

Use a rectangular piece of paper for each map. One square centimeter of paper will represent 5 million people. If your continent or region has a population of 500 million people, for example, it will require a piece of paper with an area of 100 square centimeters.

Procedure

1. To make your map of a continent or region, find its population in the table below.
2. Divide the population by 5 to learn how many square centimenters should be in the rectangle for your map.
3. Look at a map of the world to see the shape of your continent. Cut a piece of paper into a rectangle of correct area that is about the shape of your continent or region.
4. When you have finished your map, combine it with the other maps your class has made to form a world map.
5. Compare and contrast this world map with a standard world map.

CONTINENT OR REGION	ESTIMATED 1994 POPULATION (in millions)
Africa	700
North America (Canada, U.S.)	290
Latin America and the Carribean (Mexico, Central America, South America)	470
Asia	3,392
Europe	728
Oceania	28
Antarctica	0

Source: United Nations, courtesy of the Population Reference Bureau, Inc.

Citizens of the World

The world is divided into ecological regions called **biomes**, where specific plants and animals live. The type of biome depends on the climate, soils, available water, and other physical features where the region is located. Changes to biomes are occurring partly as a result of human activities and partly due to natural climatic change. Some areas are becoming deserts. Other regions are losing topsoil and forests. Some wetland areas are being drained or polluted. Still other regions are experiencing record high rainfalls or drought.

Task

Decide in what part of the world you want to live in the future. What might be your choice of location for your future community? Select a country or region of the world to study. Consider climate, vegetation, and other features. Prepare a journal that will help the class learn about the area. This country or region will be a candidate for your final selection, and you will benefit from seeing the other journals.

Student Journal

Your journal should include the following components.

Title Page. Illustrate the title page of your journal with a feature of your country or region. Include your name, date, and a summary of the contents.

Physical Geography. Make a map of your country or region. Include physical features, neighboring countries, and bodies of water that are near your region.

Demographic Data. (See list, p.20.)

Lifestyle and Access to Resources. (See list, p.20.)

Editorial Article. Select an environmental issue that applies to your country or region. Write an editorial explaining the problem, giving your opinion, and proposing possible solutions. (Include an introduction and conclusion in the editorial, and be persuasive.)

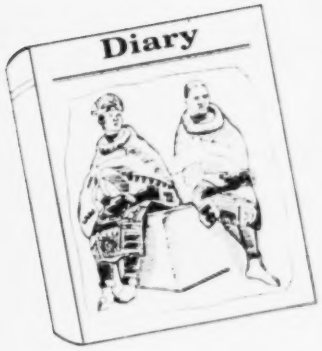
Population Summary. Prepare a one-page summary of the population of your country or region. Include population projections and government policies that might influence population growth.

Demographic Data

Use the Population Reference Bureau's World Population Data Sheet, atlases, and other references to research the following information for your country or region.

- Current population
- Birth rate (per thousand)
- Death rate (per thousand)
- Annual growth rate (percent)
- Doubling time at present rate (in years)
- Projected population in 2025
- Infant mortality rate (per 1000 live births)
- Total fertility rate (for childbearing years)
- Percentage of population younger than 15 years
- Percentage of population older than 65 years
- Life expectancy (in years)
- Urban population (as percentage of the total)
- Percentage of married women using contraceptives
- Government policy on birth rate (favoring a high, medium, or low rate)
- Per capita gross national product (in U.S. dollars)

Lifestyle and Access to Resources



Imagine that you are a student with an average lifestyle in your country or region. Write a one-page diary describing your typical day. Then prepare an information sheet on the area. Describe the average student's lifestyle and access to the following resources and services:

- Food
- Housing
- Water supply
- Clothing
- Toys and recreational equipment
- School
- Health care
- Transportation
- Communication
- Entertainment
- Recreation

More/Less Activity

Students consider the positive and negative effects of population growth on the environment and express these connections using a futures wheel.* They begin to plan for their future communities by making a tentative choice of community size and creating a preliminary plan for limited development.

Visit from a Planner

Contact your city planning office and invite a city planner to talk to your class about land use and development. If you live in a rural area, contact a member of your county commission or local water or agricultural board. Tell students to take careful notes so they can use the information for planning their community's development.

Extensions

1. Have the class debate issues related to population growth: (a) Is increasing population necessarily a problem, and is population control the only or best solution? (b) To what extent does use of resources in more developed countries contribute to a population crisis, and should anything be done to limit population growth or use of resources in these countries?

2. Interview adults of different ages to determine their thinking on whether a population crisis exists and what, if anything, should be done about it.

3. *Environmental Science Activities Kit* by Michael L. Roa (The Center for Applied Research in Education, Englewood Cliffs, New Jersey, 1993) has an activity in which students write a letter to their grandchildren. In the letter, they explain the current world population status and their predictions and hopes for the future.

*Cyndy Guy and Jerry Glenn originated the idea of the futures wheel.

More/Less Activity

In *The Population Bomb* (second ed., 1978), biologist Paul Ehrlich suggested that excess human population has overloaded the environment and human communities, resulting in billions of tons of topsoil lost and trillions fewer gallons of groundwater for growing food crops. Overpopulation would result in more deaths from starvation and disease, he wrote.

Are exploding populations causing famine, disease, deforestation, and pollution? Is Earth overpopulated?

Dennis Ahlburg of the University of Minnesota's Center for Population Analysis and Policy believes the real problem is that societies encourage waste. As a result, we are losing the resources needed to provide for increased populations.

Julian Simon, a business professor at the University of Maryland, College Park, feels that people are producers as well as consumers. As a resource becomes scarce, he says, people will find ways to use it more efficiently, get more of it, or develop substitutes. We don't necessarily have to have more oil or coal, just more energy, and we can figure out ways to provide it.

The question then is, What is the carrying capacity of Earth? How many people is too many? Can world population keep growing?

Task

How does population growth affect resources like food, land, air, water, and energy? How does it affect quality of life? You will make a connections map to show the effects of increased population of the world.

Making Connections

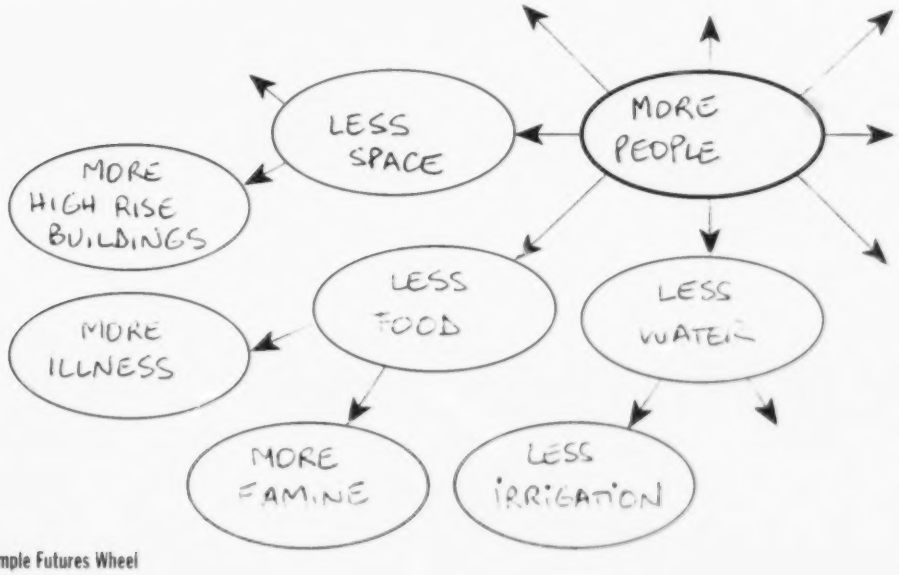
Use the futures wheel on the Activity Sheet to show connections between population growth and social and environmental factors like food and development. Some examples:

MORE PEOPLE = more medical research = less disease

MORE PEOPLE = more food needed = more land used for crops = less forest left

MORE PEOPLE = more transportation = more fossil fuel used = more sources of energy needed

1. Start by listing 12 or more environmental factors and human population characteristics that could be affected by increased population. (Some examples are extinction of species, human conflict, water quality, quality of life for future generations, and technology development.)
2. Write "MORE PEOPLE" in the center circle of the futures wheel.
3. Make some "more" and "less" connections and enter them in your futures wheel. Try to fill in all the blanks.
4. If you run out of space, draw a larger futures wheel on a sheet of paper. As the sample shows, there are no restrictions on the number of connections.

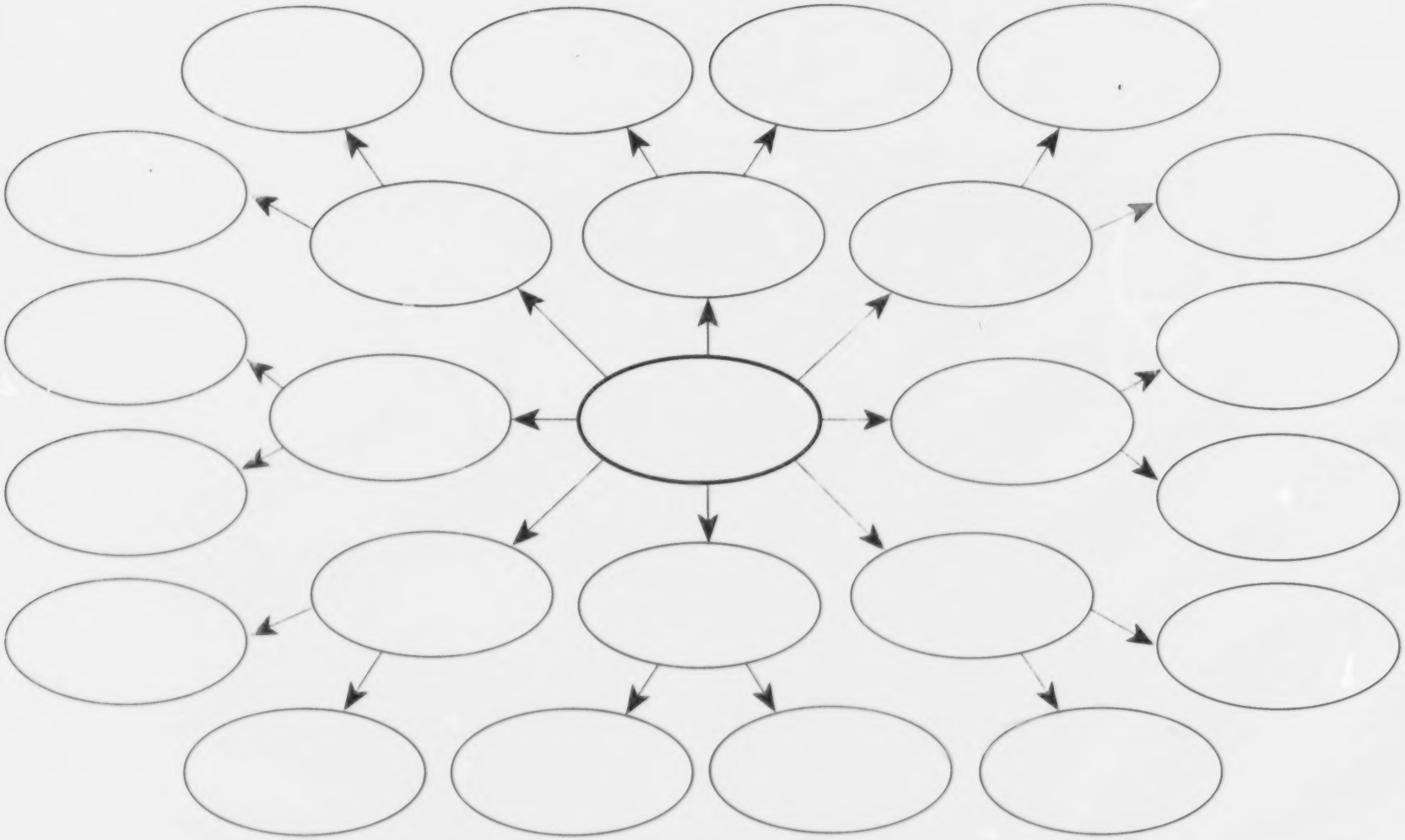


Sample Futures Wheel

Planning Development of Your Community

1. After you have finished your futures wheel, decide what size you would like your future community to be. Explain your reasoning.
2. What effect would population growth have on your community?
3. Devise a plan for limited development within your community. Keep this plan and refer to it when you begin to design your future sustainable community.

A Futures Wheel



*Cyndy Guy and Jerry Glenn originated the idea of the futures wheel.

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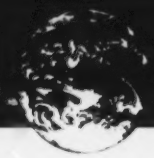


Looking at *Lemna*

Populations grow exponentially without limiting factors. When modeling exponential growth, it is useful to use living organisms whose growth can be easily measured, such as *Lemna*, an aquatic plant.

World population has been growing at about 2 percent per year. Is this fast? And why is it happening?

In this activity, data collected from the study of *Lemna* growth are compared graphically with world population data. Students learn about exponential growth and related concepts and practice interpreting graphs.

Teaching Notes

Advance Planning: Begin the experiment in advance, so students can collect data for several weeks.

Materials: *Lemna* can be collected from ponds or purchased at a biological supply house. For team set-ups, use 1000-milliliter beakers and place them under grow lights with an aerator in each. Or students may grow their own populations of *Lemna* in baby food jars.

Modification: If *Lemna* plants are not readily available, have students raise red or black flour beetles, available from biological supply houses. They complete their life cycle in three weeks and provide interesting specimens for the students to study under a microscope.

Class Activity: Growth Graphs

Complete this activity before finishing the population growth study. Find graphs related to population growth in newspapers and periodicals. Divide the class into groups of two to four students, and provide each group with a graph. Have them follow these steps as they analyze the graph. If time permits, give each group a second graph to analyze.

1. Look only at the graph and its labels. What can you say about the information and its source?
2. Looking at the entire graph, including the title or caption, what else can you say about the graph?
3. What information about the issue illustrated by your graph is not on the graph?
4. What is the most important result shown on the graph?

Resource

DeBuhr, Larry. (1991, April). Using Lemna to Study Geometric Population Growth, *American Biology Teacher, (53)*4, 229–232.

Looking at *Lemna*

This activity uses a small, floating, aquatic plant of the genus *Lemna* (known as duckweed) to demonstrate exponential population growth. *Lemna* is a plant that reproduces at a rapid rate. It is small but can be easily seen and counted.

As individual *Lemna* plants grow and enlarge, they split in two to form new plants. *Lemna* can double in number in less than five days if growing conditions are right. As *Lemna* grows and reproduces, it forms a population of floating plants on the surface of the water. In 6 months, a small number of *Lemna* will multiply to cover the surface of a 37.8-L (10-gallon) aquariúm with an estimated 10,000 individual plants.

Task

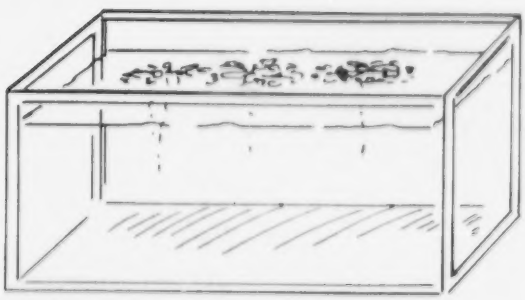
As a class, you will grow *Lemna* in an aquarium for several weeks and count the number of plants as they multiply. You will then compare the growth of the *Lemna* and the growth of world population over the past 2,000 years.

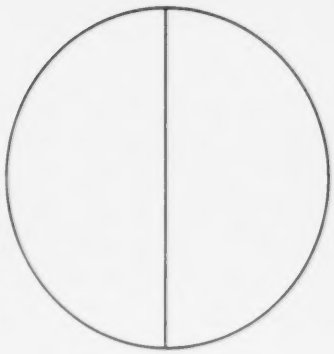
Materials

- 37.8-liter (10-gallon) aquarium with pump and light
- 10 *Lemna* plants
- Tap water (allowed to stand overnight)
- Acetate centimeter grid (optional)

Procedure

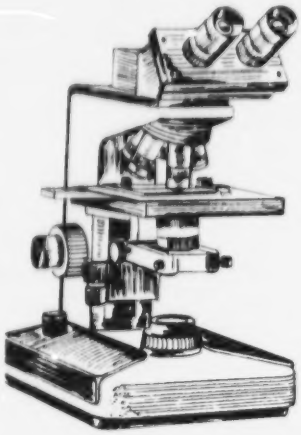
1. Set up the aquarium with aged water aerated with a single pump. On the day you begin the activity, place 10 *Lemna* plants in the tank. Leave the aquarium light on at all times. When water begins to evaporate from the tank, replace it with aged tap water.





2. When do you think there will be 20, or twice as many, plants? Try to predict the reproduction rate of *Lemna*. Observe the plants under a microscope and make an enlarged sketch of a *Lemna* plant. Then draw a *Lemna* plant that is about to reproduce.

3. Make a chart with columns for date of observation and population size. Help your class count the number of plants every two days. At first, counting will take only a few minutes. After several days, the population will increase significantly. "Spurts" in reproduction are to be expected and relate to growth and development of the *Lemna* colony. After several weeks, the number of plants in the aquarium will become too large to count easily.



4. You can use this method to estimate the number of plants.
a. Calculate the surface area (length × width) of the water at the top of the aquarium. (In English measure, an aquarium that holds 10 gallons is 20 inches long and 10 inches wide. You will be making all measurements and calculations in metric measure, so the aquarium holds 37.8 liters and is 51.28 cm long and 25.64 cm wide.)
b. Average, from ten samples, the number of *Lemna* plants per square centimeter.
c. Estimate the percent of the surface covered by the plant.
d. Calculate the estimated population size by multiplying a × b × c.

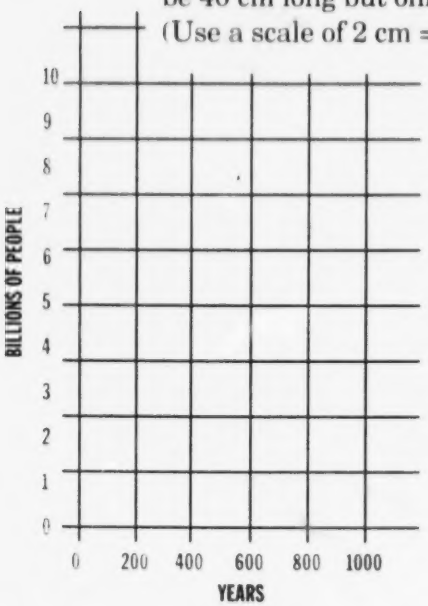
Sample calculation: If you find an average of 30 *Lemna* plants in a square centimeter and the plants cover half the water surface, then the population size is:
(1,314.82 cm^2) (30 plants/cm^2) (.50) = 19,722.3, or about 20,000 plants. (Remember: 50% = 50/100 = .50)

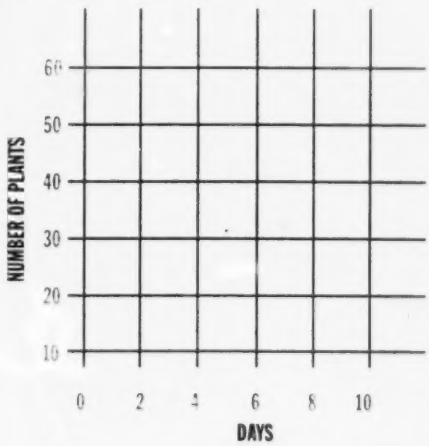
You can also use a grid system to estimate the number of plants. Use a clear-acetate centimeter grid. Hold the grid over the *Lemna* and outline the area that is filled with plants

using an overhead marker. Count the number of centimeter squares containing plants and multiply that number by the average number of *Lemna* you found in each square.

5. When you decide to end the experiment, graph the results.

6. Using the data in the table below, make a graph of world population from the year 1 to the year 2050. Use two sheets of paper, taped together end to end, because your graph will be 40 cm long but only about 8 cm high. (Use a scale of 2 cm = 100 years)





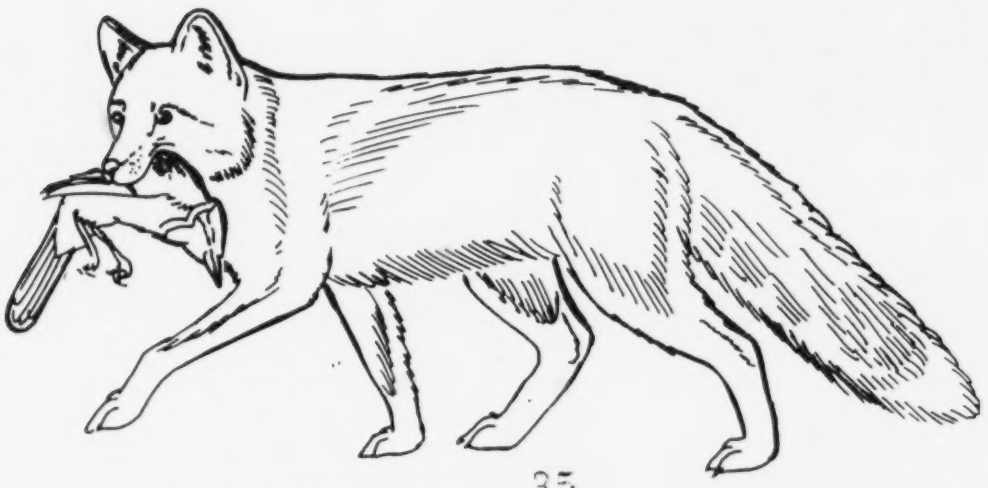
World Population

Year (A.D.)	Population (in millions)	Year (A.D.)	Population (in millions)	Year (A.D.)	Population (in millions)
1	170	1200	360	1800	900
200	190	1300	360	1850	1,210
400	190	1400	350	1900	1,625
600	200	1500	425	1950	2,515
800	220	1600	545	1995*	5,759
1000	265	1700	610	2000*	6,228
1100	320	1750	760	2025*	8,472
*Projected figures				2050*	about 9,000

Data through 1975 are from The Atlas of World Population History by C. McEvedy and R. Jones, New York: Penguin Books, 1978. The other data are from the United Nations, courtesy of the Population Reference Bureau, 1875 Connecticut Avenue NW, Suite 520, Washington, DC 20009.

Analysis

1. How do the *Lemna* and world-population graphs resemble one another? How are they different?
2. Analyze your graphs and predict future populations if growth rates remain the same.
3. What is meant by doubling time? What do you think is meant by exponential growth?
4. What might happen to a plant or other organism if its growth is unrestricted, and what might happen to the surrounding environment?
5. If organisms follow an exponential growth curve, why isn't the world overpopulated with plants and animals?
6. What keeps natural populations of organisms from becoming overpopulated? What natural factors help control population sizes?
8. What is meant by limiting factors? What is meant by carrying capacity?
9. What is meant by overpopulation? How does population size relate to carrying capacity?
10. How (or whether) to control human world population is an important issue. On September 13, 1994, in Cairo, Egypt, the United Nations Population Conference endorsed a document intended to guide efforts to curb population growth over the next 10 to 20 years. How would you expect the



graph of human population to change in the next 100 years if the recommended strategies are put into effect? Describe how the graph of population would change. Explain your prediction.

Conclusion

Summarize (1) what you have learned about exponential growth and (2) the trends for growth of the world's human population. (3) Describe the kind of growth you observed when studying the *Lemna* plants.

Dispose of the *Lemna* plants by putting them in your compost heap or using them as mulch on flower beds.

Renewable Energy Activity

In the United States, we rely mostly on fossil fuels and nuclear energy to generate electricity. How will future generations meet the need for electricity when traditional sources become rare or too expensive? Students investigate alternate fuels and new energy technology to design a product that runs on a renewable energy source or a renewable energy system that may be used in the future communities project.

Teaching Notes

Advance planning: Contact your media specialist at least two weeks in advance and submit a copy of the activity so there is sufficient time to borrow additional references on renewable energy options from other schools in your system.

Time Required: Allow two days for research and an additional week for students to complete their designs before scheduling presentations.

Community resources: You may also ask that students write a letter to a renewable energy company or professional association requesting information.

Modification: Younger students may all be assigned the design of a solar home. Homes can include both active and passive solar applications, for example, collectors, photovoltaics, and south-facing windows.

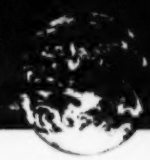
Extension

While students work on their projects at home, use class time for experiments on solar energy, biomass conversion, and wind power. Check environmental science books and laboratory manuals for appropriate activities. If your school has a technology department, photovoltaic cells may be available for demonstrations.

Resources

• Scott Resources, Inc., P.O. Box 2121, Fort Collins, CO 80522 (Telephone:1-800-289-9229), sells a solar home model for doing experiments.

• Energy Efficiency and Renewable Energy Clearinghouse (Telephone: 1-800-523-2929). Department of Energy information. For schools, DOE gives away its *Hands-on Energy Education Kit* (1994); specify grade level.



Renewable Energy Activity

Meeting energy needs will be one of the greatest challenges of future generations. Select a source of renewable energy to research. After gaining an understanding of the energy source you have selected, you will design and construct a technological product that is powered by that source.

Renewable Energy Sources

- Biomass
- Falling water (hydroelectricity)
- Geothermal fields
- Sunlight
- Temperature differences between ocean layers (ocean thermal conversion)
- Waves and tidal currents
- Wind

Task

Think about essential energy needs. Design either a product that uses a renewable energy source or a renewable energy system, to help meet the energy needs of the future.

Part A: The Product or Energy System

Choose one of the following:

1. Build a product that actually runs on renewable energy.
2. Build a model of a product that runs on renewable energy.
3. Design a renewable energy system that will provide for all the energy needs of a future community. (Example: a mini-field of windmills.)

Part B: Written Report

In your written report, describe your product or system and include the following information. Include original diagrams.

1. Explain how your renewable product functions.
2. Describe how the energy source for your product is renewable.
3. Tell whether your product or system is cost effective and energy efficient and explain why.
4. Describe the effect of your product on the environment and discuss any ethical issues involved.

5. List the positive and negative effects your product has on society.

Include a bibliography or list of resources. Since knowledge in the field of renewable energy is expanding daily, one of your sources should be either a personal interview with someone in the field or an article published within the past year. (See the list of resources at the end of this activity.)

Part C: Presentation to the R & D Committee.

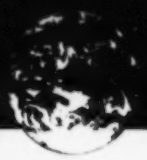
Prepare materials for a presentation. Include your model and written report, appropriate diagrams, and any other mediums you choose (computer graphics, posters, slides, videos).

You will make a five-minute presentation to the class, who will be the R & D (Research and Development) Evaluation Committee. Based on your presentation, they will decide whether your product should be considered for production. For your presentation include:

1. A demonstration of how your product works, or of how your system operates
2. A brief explanation of your use of the renewable energy source
3. An assessment of the positive and negative effects of your product or system on the environment and on society

Some Product Ideas (There Are Many More!)

- Solar water heater
- Solar cooker
- Solar collector
- Solar concentrator
- Solar oven
- Solar vehicles
- Solar storage device
- Solar calculator
- Photovoltaics to operate a switch
- Model water wheel to power a flour mill
- Wave or tidal action harnessed to light a town
- Wind generators to provide electricity for street lights
- Model wind generator to power a recycling plant
- Model methane generator to heat a swimming pool
- Wind-powered machines to pump water
- Methane from biomass
- Model geothermal plant
- Solar rotisserie
- Solar food dehydrator
- Solar house
- Biogas to power a room-sized heater
- Photovoltaic cells to light a light bulb



Sources of Information

You may want to send for information from companies that use renewable energy sources to make their products.

Another good contact is the National Renewable Energy Laboratory (1617 Cole Blvd., Golden CO 80401.) For general information, address your questions to the Center for Science Education (Telephone: 303-275-3061). For more technical questions, address your questions to the Technical Information Department (Telephone: 303-275-4099).

Other resources:

- American Wind Energy Association, 122 C Street NW, 4th Floor, Washington, DC 20001 (Telephone: 202-383-2500. Fax: 202-383-2505).
- Geothermal Education Office, 664 Hilary Drive, Tiburon, CA 94920 (Telephone: 415-435-4544).
- Solar Energy Research and Education Foundation, 777 North Capitol Street NE, Washington, DC 20002 (Telephone: 202-289-5370. E-mail: info@crest.org).
- Solar Electric Power Systems, Photocom, Inc. 7681 East Gray Road, Scottsdale, AZ 85260.
- Renewable Fuel Association, 1 Massachusetts Avenue NW, Suite 820, Washington, DC 20001 (202-289-3825).

Indigenous Peoples of the World

Students learn about the distribution of indigenous cultures by plotting locations on a world map. Each student researches an indigenous culture to learn the effects of world population increase and improving technology.

Teaching Notes

Each student selects a different group, to have a complete picture of indigenous peoples worldwide. If there are more students than indigenous groups, some students may research refugee populations.

A Study of Conflicts

About 200 million people belong to indigenous cultures. With ever-increasing world population, the lands of indigenous peoples are being "discovered" and "civilization" is being brought to the regions.

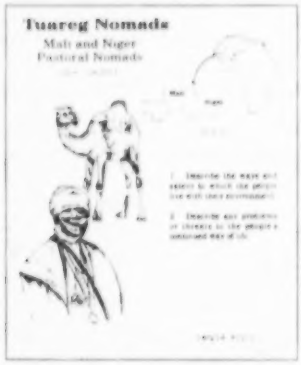
To help students understand the effect of development and the conflict it often creates, discuss some historic confrontations. Use a jigsaw activity, with each group investigating an event from history involving such confrontation, then reporting to another group. Have students record where each conflict occurred and between which groups, the goals of the newcomers to the area, and the outcome of the conflict. Include the effect the conflict had on the environment in the region. Examples include:

- The Spanish Conquistadores, led by Cortez, who landed in Central America in the region of the Aztec empire.
- Captain Cook and the "First Fleet," who landed in Botany Bay in Australia, home to the Aborigines.
- The settlers of the American West (farmers, miners, and ranchers) and Native Americans.

Extensions

1. Have students check newspapers and magazines for articles about displaced indigenous peoples and write short summaries of the articles.

2. For younger students, create a bulletin board and post articles about native people and refugees.



Indigenous Peoples of the World

About one in every 25 people worldwide, or almost 200 million people, belong to indigenous cultures. The original inhabitants in a geographic region, who usually live in relative harmony with the environment, are referred to as indigenous peoples. Many of these peoples have been affected by subsistence farmers, miners, ranchers, and technological projects that have displaced them. Development often has introduced health problems. Indigenous peoples today are scattered. The majority are in Asia, mostly in China and India.

Task

Using a world map and information provided, plot the locations of the major groups of indigenous peoples. Then select one group and research its culture.

SYMBOLS

- * **hunters**
- ¬ **gatherers**
- \+ **shifting cultivators**
- • **pastoral nomads**
- # **settled farmers**

Presentation

Prepare a poster to display in the classroom. Artwork on the posters is helpful but not required. On your world map, include a Title, Orientation, Date, Legend, and Scale (TODLS). (The scale is probably already on the map.) For the legend, use the symbols (in left margin) or create your own.

Attach your map to the poster and highlight the region where the indigenous people you researched are located. Add the following information to the poster.

1. Describe the ways and extent to which the people live in harmony with their environment
2. Describe any problems or threats to the people's continued way of life.

Asia and Its People

This activity focuses on current environmental and other problems faced by people in Asia and the Pacific region. Students select a country and study what is being done to solve these problems and meet the needs of people in this region.

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Indigenous Peoples

NUMBER	PEOPLE	LOCATION	BEHAVIOR	THREATS
1	Pygmies	Western and Central Africa	hunters and gatherers	
2	Tuareg Nomads	Mali and Niger	pastoral nomads	
3	Bororo peoples	Africa		Expelled from Central African Republic
4	Masai, Degodia, and Somali	Kenya	pastoral nomads	
5	Bushmen	Botswana	hunters and gatherers	
6	Hill tribes of Chittagong	Bangladesh		settlers moving in
7	Karen peoples	Thailand	shifting cultivators and farmers	
8	Punan, Kenyah, and Hayan peoples	Malaysia		logging and hydroelectric power
9	Manoobo and Bangsa Moro peoples	Philippines	shifting cultivators and farmers	
10	Irian Jaya peoples	Indonesia		transmigration policies and oil exploitation
11	Indigenous peoples	Micronesia		U.S. and French nuclear weapons tests
12	Kanak peoples	New Caledonia	hunters and farmers	
13	Lacandon Maya Indians	Mexico		cattle ranchers and deforestation
14	Guatemalan Maya	Guatemala	farmers	forced resettlement
15	Miskito Indians	Nicaragua	farmers	civil war
16	Indian reserves	Costa Rica	farmers	development pressures
17	Guaymi and Kuna Indians	Panama		mining and development
18	Paez and Guambiano Indians	Colombia		removed from lands
19	Yagua and Amuesha Indians	Peru	hunters, gatherers, shifting cultivators	
20	Yanomami, Apinaye, and Txukarramae peoples	Brazil	hunters and gatherers	mining, hydro-electric power, and settlers
21	Ache Indians	Paraguay	settled farmers	genocide
22	Mapuche Indians	Chile	settled farmers	government threats to liquidate the Indian communities
23	Sami peoples	Finland	pastoral nomads	
24	Former Soviet Union tribal peoples	Russia	hunters and farmers	
25	Chinese Minority peoples	China	shifting cultivators, pastoral nomads and settled farmers	
26	North American Indians	Midwest and Southwest US	farmers	
27	Inuit (Eskimos)	Alaska and Canada	hunters	
28	Indian Scheduled tribes	India	shifting cultivators, settled farmers	
29	Aborignes	Australia	hunters and settled farmers	
30	Maori	New Zealand	settled farmers	
31	Pacific peoples	Polynesia	hunters and gatherers	

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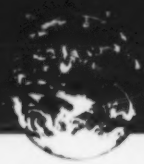


Teaching Notes

Time Required: This activity will require one or two periods for research, one period for creating the collage, and one to present students' findings. If you are short of time, assign the collage as homework.

Advance Planning for Project: Have the class take notes on student presentations and save this information for the future communities project. By now, students should have a good idea of problems and resources in different areas of the world. This information will be helpful when they defend their choice of location for their future community.

Extensions

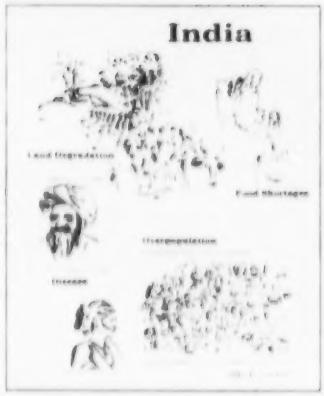
Refer to the student resource book, *Connections: Linking Population and the Environment*, edited by Kimberly A. Crews and Patricia Cancellier (Population Reference Bureau, 1991). Have the students assume the role of child number 5 billion, born in 1987. Ask students to give a three-minute presentation as a child of Haiti, Mauritania, Nepal, Yemen, or Brazil. Let the class discuss how each child differs from or resembles a child of the United States.

Resources

World Resources Institute.*World Resources, 1994–95: A Guide to the Global Environment.* (1994). Oxford, England: Oxford University Press.

Asia and Its People

Balancing population and the environment is difficult in Asia and the Pacific region, which accounted for 59 percent of the world's population in 1990. The region also has more than 70 percent of the world's agricultural population. One of Asia's greatest problems is deforestation, caused by the constantly increasing need for agricultural land and demand for wood for building and manufacturing.



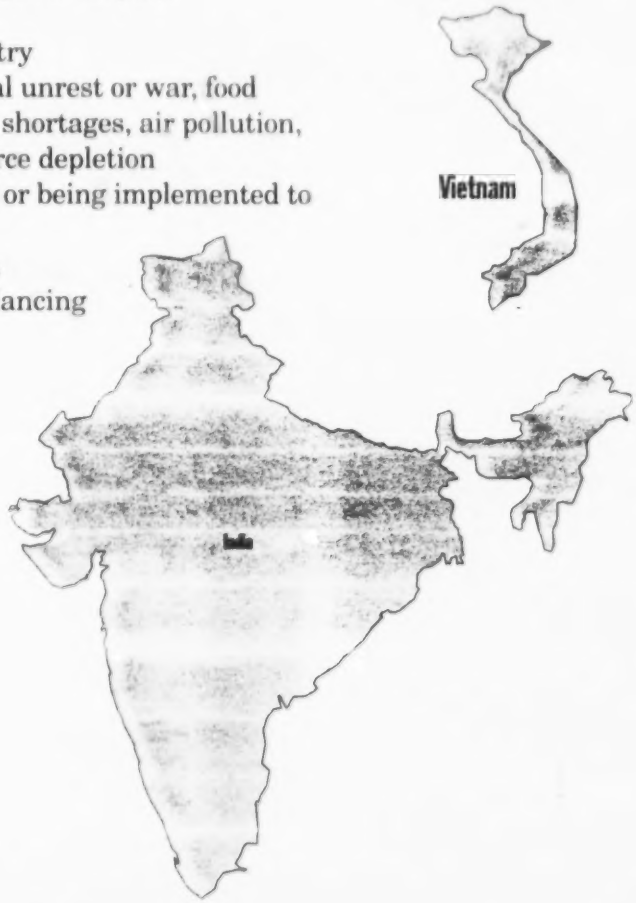
A Case Study

Select a country in Asia and the Pacific region and prepare a one-page case study. Make a collage that illustrates what life is like for people in your country. Attach your case study to the collage for display.

Include in your case study:

- The population status in the country
- Current problems, such as political unrest or war, food shortages, land degradation, water shortages, air pollution, disease, energy shortages, or resource depletion
- Strategies and solutions proposed or being implemented to deal with problems

Conclude the case study with an analysis of how your country is balancing the needs of its citizens and environmental protection.



Selection of a Country

Here are some examples of countries, problems, and related topics.

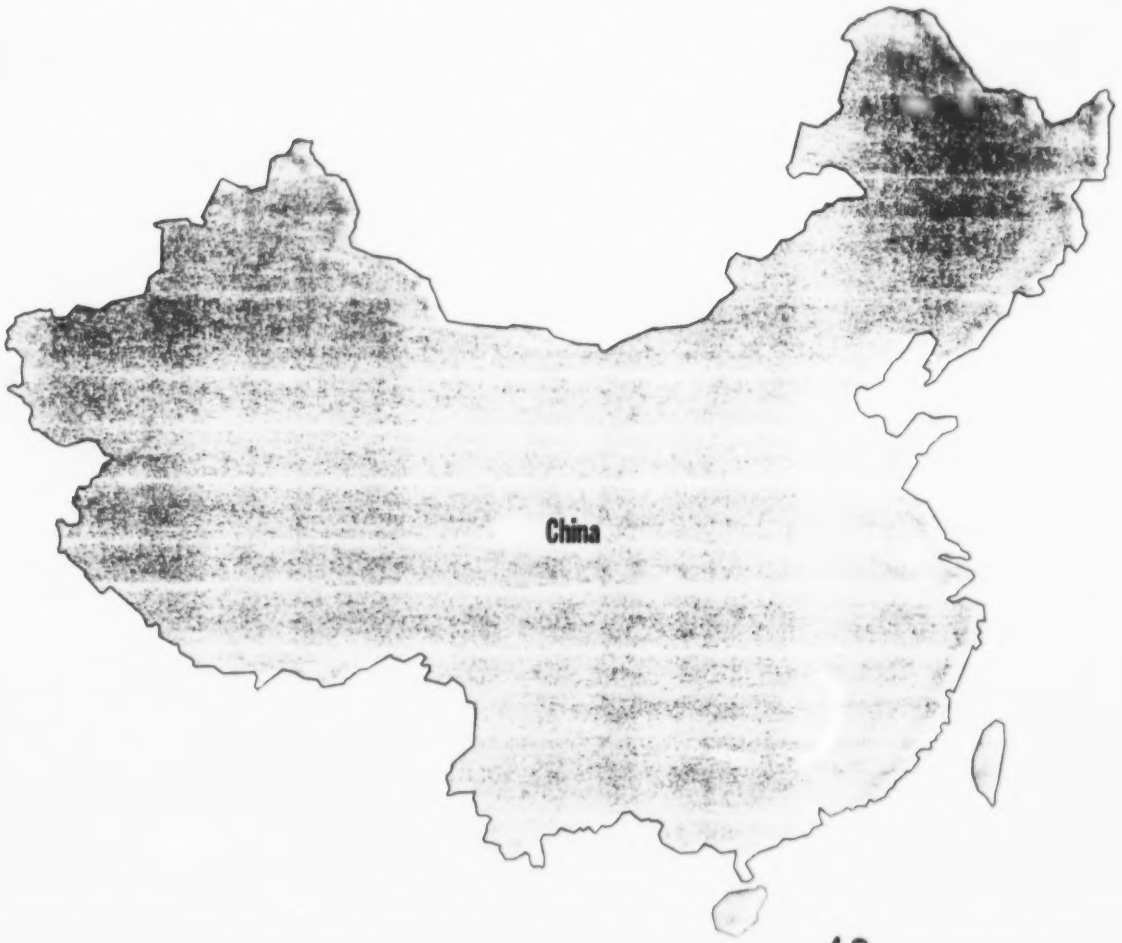
Vietnam: Destruction of forests for fuelwood; drought affecting rice-growing land.

India: Cycles of drought and flood; deforestation; grass consumption by cattle, sheep, and goats; soil erosion; construction of Bodghat and Tehri Dams.

China: Erosion of topsoil along the Yellow River (Huang Ho), Great Green Wall to protect farmlands and pastures from sandstorms and wind; erosion; water shortages; land degradation.

Bangladesh: Cycles of drought and flood; deforestation in the Himalayas; natural disasters such as cyclones and monsoons (hurricanes).

Philippines: Farming marginal lands, flooding and sedimentation; water pollution; destruction of coastal mangroves (whose roots help hold the soil) and of swamps and coral reefs.



Project Revisted: A Plan for a Future Community

Students now have an opportunity to design their communities. Planning a community requires considerable cooperative effort and individual work. Students will reach joint decisions and each will be assigned responsibility for two or more aspects of the community plan. The work culminates in collaboration on a report and presentation.

Teaching Notes

Time required: If blocked periods are available, work progresses much more quickly. Reintroduce the project during one class period, spend two to four periods on the community blueprint map, two periods on the booklet, and two periods on the presentations.

Grouping: Students should work in teams, preferably of four, so each has two proposals to prepare. If students are working individually or in smaller groups, they should be assigned two or three proposals.

Materials: Students should use their notebooks and other notes and materials from earlier activities in this unit. Provide them with markers, overheads, and any other art supplies they need.

Selection of location: You may wish to require approval of the groups' choices of location to obtain a good balance of countries.

Evaluation: Do student self-evaluations and group evaluations at the end of the presentations. Ask students to reflect on their participation as an individual and in a group. Have them consider how their community plan and presentation could have been improved.

Research

The article "Putting the Bite on Planet Earth," by Don Hinrichsen, in the September/October 1994 issue of *International Wildlife* (Vol. 24, no. 5, pp. 36-45) summarizes the current state of human population and global natural resources. Provide students with copies of the article and a highlighter. Students should extract the main ideas from

the article and use whatever information is helpful to their project.

The January/February 1995 issue of *Nature Conservancy* (Vol. 45, no. 1) is devoted to the concept of sustainable worlds. Several articles deal with sustainable development. Using the article "The Question of Sustainable Development" (pp. 10-15), have students read the opinions of nine experts and summarize their viewpoints. This could be done as a jigsaw activity.

Suggested Resources

- Bongaarts, John. (1994, March). Can the Growing Human Population Feed Itself? *Scientific American, 270* (30), 36-42.
- Bray, Francesca. (1994, July). Agriculture for Developing Nations. *Scientific American, 271* (1), 30-37.
- Ehrlich, Paul R., and Ehrlich, Anne H. (1988, December). Population, Plenty, and Poverty. *National Geographic, 174* (6), 914-945.
- Fox, Robert W. (1984, August). The world's urban explosion. *National Geographic, 166* (2), 179-185.
- Hubbard, Harold M. (1991, April). The real cost of energy. *Scientific American, 264* (4), 36-42.
- Kates, Robert W. (1994, October). Sustaining life on the Earth. *Scientific American, 271* (4), 114-122.
- Repetto, Robert. (1992, June). Accounting for enviromental assets. *Scientific American, 266* (6), 94-100.

Project Revisited: A Plan for a Future Community

Now that you have learned more about human populations, it is time to design your future community. Before you begin planning, you or your team must make some decisions about the location, size, and character of your community. Except for suggestions from your teacher, there will be few restrictions on your choices—only those required to make your community sustainable and satisfy the needs of the inhabitants.

The year of your future community is 2030, when the world population is projected to be about eight and a half billion. You must make decisions that will continue to serve your community well and far into the future.

Task

Design a sustainable future community for the year 2030. Begin with a population of about 100 (for a village) to 100,000 (for an urban area). Decide what kind of community you would like and create a plan that includes the following proposals for meeting the needs of the community.

The Proposals

1. Accommodate population growth or limit growth over the next 40 years, or both.
2. Include land for (a) agriculture; (b) industrial, commercial, residential, and mixed use; and (c) common areas, parks, forests, and nature preserves. Land-use policy must provide for protection of wildlife habitat.
3. Allow for local food production, or plan to supply food from producing areas away from your area.
4. Use renewable energy and practice energy conservation.
5. Conserve water and use it wisely. Protect wetlands, swamps, oceans, rivers, other bodies of water, and all sources of fresh water.
6. Maintain clean air, water, and land. Include plans for waste disposal.
7. Plan for resource aquisition, conservation, and recycling. Include water, lumber, minerals, and textiles, but not food or energy sources.

8. Maintain a good quality life for the entire population. Consider health, happiness, education, work, recreation, and political stability.

Instructions

Throughout this project, refer to the notes you took about your community, your journals, and other information you have gathered about human populations worldwide.

Divide the proposals among team members. Unless otherwise instructed, each member should focus on two proposals. You will work individually, but should consultat with other team members.

Before you can begin this work, the team must make some basic decisions about the community. You should also make some personal decisions: What will be your role in this community in the year 2030? How old will you be? (Choose your age.) What kind of work will you do? Will you have a family? Where will you live? How much longer will you work before you retire?

Step 1: Decision Making

Discuss the following topics and try to reach consensus on the decisions. Consult your journals and share knowledge, notes, and materials that may be helpful.

1. What do you think sustainable development means? Exchange ideas on how you plan to keep your community sustainable. Decide on the team's strategies after you have made the rest of these decisions.
2. In what part of the world will your community be located? Explain why you chose this location.
3. What will be the starting population size of your community? How large a land area will the community occupy? (Give the dimensions in square kilometers or hectares.) Make some decisions about the nature of the development and other characteristics of the community.
4. Will there be any restrictions on the maximum population size of your community? Will you try to limit the rate of growth and development?
5. What natural resources are available in the region you selected? Which resources must you import? Which may be difficult to obtain?

6. What future technological advances will be necessary for your community to remain sustainable?

Step 2: The Community Plan

As a group, begin a rough drawing of your community on a large sheet of paper. Include TODLS (Title, Orientation, Date, Legend, and Scale) on your map. When the rough draft is finished, transfer the information to poster board or butcher paper for your team's presentation to the class. You will complete this poster later.

Work individually on the proposals you have selected as part of the plan for your future community. Use information from previous activities in this unit and gather information from the media center and other sources. Write up your proposals.

Step 3: The Presentation

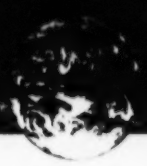
As a team, combine all eight proposals with a cover page and bibliography to create a final booklet. Make any necessary changes to your poster. Prepare to present your community plan to the class. Be ready to describe your future community and explain why you believe it is sustainable. Use any of the following or any other presentation materials:

- Diagrams
- Blueprints
- Slides
- Models
- Photographs
- Videotape
- Maps
- Transparencies

Step 4: Evaluations

The class's presentations will give you another opportunity to consider aspects of life in the future. To provide feedback for your peers, prepare an evaluation of other presentations. Write your name, the date, and the names of the team members for each presentation, and record the following information.

1. Where is the future community located?
2. Do you think the community is sustainable?
3. What effect do you think the community has on the environment?
4. Give two positive comments on the team's work.
5. Give two negative comments on the team's work.



Resources

Books and Other Items

Dockterman, David, and Lewbel, Arthur. *Decisions, Decisions: The Environment.*. (Computer simulation available from Tom Snyder Productions, 80 Coolidge Hill Road, Watertown, MA 02172. Telephone: 1-800-289-9229.)

"The Earth at Night." (1986). (Poster available from Astronomical Society of the Pacific, 390 Ashton Avenue, San Francisco, CA 94112. Telephone: 415-337-2126.)

Ehrlich, Paul R. (1978). *The Population Bomb.* second edition, New York: Ballantine Books.

Lear, Geoffrey, Hinrichsen, Don, and Markham, Adam. (1990). *Atlas of the Environment.* New York: Prentice Hall.

Hammond, Allen. (Ed.).*World Resources.* 1994-95: The World Resources Institute, New York: Oxford University Press.

Wasserman, Pamela, and Doyle, Andrea. (1991). *Earth Matters.* Washington, DC: Zero Population Growth, Inc..

Agencies and Organizations

Environmental Protection Agency, 401 M Street SW, Washington, DC 20460

• Film series from EPA: *Global Designs for Sustainable Environment* includes "Beyond Business As Usual: Meeting the Challenge of Hazardous Waste," "Sustaining America's Agriculture: High Tech or Horse Sense?" and "Transportation 2000: Moving Beyond Auto America."

Population Reference Bureau, 1875 Connecticut Avenue NW, Suite 520, Washington, DC 20009. Telephone: 202-483-1100.

Worldwatch Institute, 1776 Massachusetts Avenue, NW, Washington, DC 20036. Telephone: 202-452-1999.

Zero Population Growth, Inc., 1400 16th Street NW, Washington, DC 20036. Telephone: 202-332-2200.

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